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United States General Accounting Office
Report to the Secretary of the Navy

GAO

January 1991

ANTISUBMARINE WARFARE

Tactical Surveillance Sonobuoy and Related Software Need to Be Tested Together

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GAO/NSIAD-91-41

National Security and
International Affairs Division

B-240536

January 9, 1991

The Honorable H. Lawrence Garrett, III
The Secretary of the NavyDTIC
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Dear Mr. Secretary:

This report presents ^{an}our evaluation of the revised acquisition strategy for the Navy's Tactical Surveillance Sonobuoy Program. The program's objective is to develop an air-deployed expendable sonobuoy and aircraft computer software to be used together in locating hostile submarines.

Background

Hostile submarines can be detected by sonobuoys that are dropped into the ocean from antisubmarine warfare aircraft. Sonobuoys detect noises radiating from various sources on a submarine and transmit this information by radio to the aircraft. The aircrew uses computers and other equipment to analyze the information to identify, locate, and attack the submarines.

To be effective operationally, the tactical surveillance sonobuoy must be integrated with the aircraft software. Although the sonobuoy itself is fairly well along in design, development of the aircraft software has been delayed. The Navy does not expect the needed software to be ready for integrated testing until 1 year after the sonobuoy development models become available. The necessary software is being designed as part of a separate Navy program that involves the development of several software enhancements for antisubmarine warfare aircraft.

The Tactical Surveillance Sonobuoy Program was originally scheduled for a full-rate production decision in late 1990. The decision was to be based on the results of operational test and evaluation of the complete sonobuoy system, that is, the sonobuoy and the aircraft software. The acquisition strategy was changed in 1988 to incorporate a low-rate initial production decision in 1991 and a subsequent full-rate production decision in 1993. Under the revised strategy, the Navy plans to spend about \$33 million in fiscal year 1992 to procure up to 9,850 sonobuoys based on the results of operational test and evaluation of just the sonobuoy. Operational test and evaluation of the integrated sonobuoy and aircraft software is now scheduled for fiscal year 1993 to support a full-rate production decision.

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Results in Brief

The Navy's revised acquisition strategy introduces added risk into the Tactical Surveillance Sonobuoy Program because the sonobuoys may need to be modified if deficiencies become apparent in the fiscal year 1993 operational test and evaluation. Also, if the development of the aircraft software is further delayed, the Navy would not be able to use the sonobuoys for some time after they are delivered. Finally, the revised strategy contradicts Navy guidance, which generally requires operational test and evaluation of an entire system before production is authorized. The Tactical Surveillance Sonobuoy Program is not an exception to this rule.

Program History

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In 1984 the Navy recognized that Soviet submarines were becoming quieter. In response, the Navy presented several antisubmarine warfare initiatives, including the Tactical Surveillance Sonobuoy Program, to Congress in 1986. Enhanced capabilities that the tactical surveillance sonobuoy will have, which no other existing sonobuoys have, include a 5- to 7-day operating period, a computer that analyzes underwater sounds and records and stores those sounds when the analysis suggests that the sounds are coming from a hostile submarine, and faster-than-normal speed transmission of data. These features are expected to reduce the use of current shorter-life tactical sonobuoys and allow each aircraft to monitor significantly larger areas than can be covered with current sonobuoys. The sonobuoys are intended for use with the Navy's current P-3C and planned replacement antisubmarine warfare aircraft. The Navy currently plans to procure almost 61,000 of these sonobuoys during fiscal years 1992-97 at a total cost of about \$288.6 million.

The Navy devised a plan to develop the sonobuoy system in two stages. The first stage was to develop a sonobuoy, as soon as possible, that would require only minor modification to existing aircraft software to operate. Development and operational testing for this sonobuoy had been scheduled for 1990 and a full-rate production decision for late 1990. The second stage was to develop a sonobuoy with enhanced capabilities to be integrated with new aircraft software. No timetable was defined for this stage.

The Navy sent requests for proposals to contractors in February 1987. In September 1987 Hazeltine/Sippican Joint Venture and Magnavox Electronic Systems Company were each awarded a fixed-price incentive, full-scale engineering development contract to develop the first sonobuoy design. However, during development the Navy modified the contracts to add enhancements to the sonobuoy that could be fully used



only with aircraft software being developed under another acquisition program. The contracts were awarded for about \$10.2 million and \$9.1 million, respectively, but their current values are \$15.6 million and \$15 million, respectively.

Production Decision Is Planned Before Integrated System Will Be Tested

In 1988 the Navy revised its original acquisition strategy for the Tactical Surveillance Sonobuoy Program to include a low-rate initial production decision before operational test and evaluation of the integrated sonobuoy and aircraft software. The original acquisition strategy was to complete operational test and evaluation of the integrated system before a full-rate production decision. The change was made because development of the aircraft software has been delayed and is not scheduled to be completed by the time the sonobuoy will be ready for testing. Under the revised acquisition strategy, only the sonobuoy's performance will be tested before the low-rate initial production decision, scheduled for September 1991. The full-rate production decision is currently scheduled for August 1993. Navy officials advised us that the risk of producing the sonobuoys before they are tested with the software has not been documented.

If the low-rate production decision is approved, the Navy plans to spend nearly \$33 million in fiscal year 1992 procurement funds to buy as many sonobuoys as possible, depending on the sonobuoy's final negotiated unit price. Various contract options have target unit prices ranging from about \$3,350 to \$5,200, which will allow the Navy to buy from about 6,350 to 9,850 sonobuoys.

Revised Strategy Introduces Additional Risk

The Navy's revised acquisition strategy adds risk to the program because sonobuoys are to be produced before the integrated sonobuoy and new aircraft software pass operational test and evaluation, and these sonobuoys may need subsequent modification to be effective. Also, further delays in the development of the aircraft software or its failure to pass operational testing and evaluation would result in the procurement of sonobuoys before they could be used.

According to Navy program officials, testing the sonobuoy before testing the integrated sonobuoy and aircraft software would reduce program risk by isolating problems to either the sonobuoy or the software. We agree that separate testing would help to isolate problems. However, we do not believe that successful testing of the sonobuoy alone is sufficient to ensure that the sonobuoy and aircraft will work integrally as a

system. Operational test and evaluation of the integrated system could reveal design deficiencies requiring all sonobuoys produced before the testing to be modified.

Navy officials also stated that starting production after operational test and evaluation of the sonobuoy would enable them to meet the initial operational capability date. The initial operational capability date, which is classified, is when a specified quantity of sonobuoys needs to be available for operational use against the postulated threat. According to Navy officials, if production is not started until after the sonobuoy and software are tested together in 1993, the initial operational capability date will not be met. However procuring the specified number of sonobuoys by the initial operational capability date may not be as critical because of reduced tensions with the Soviets.

Revised Strategy Contradicts Policy

The revised acquisition strategy does not follow Navy guidance on starting production. The Navy instruction states that

"the objective of the acquisition process should be for systems to complete development and meet all technical and operational thresholds through full developmental test and evaluation and operational test and evaluation before an approval for full-rate production decision for production line start up. This objective can be met in most smaller programs."

The instruction's intent is "to minimize the risk that early production items may have to undergo costly rework later." The instruction also states that approval for low-rate production is usually reserved for large programs that require extensive production line effort.

The tactical surveillance sonobuoy does not meet the criterion of a large program, according to the dollar amounts defined in the instruction. Furthermore, the program does not require an extensive production line preparation effort. Neither contractor anticipates any problems in producing the sonobuoy, and both are confident that deliveries could begin 1 year after the production contract is awarded. This minimizes the need to begin production before operational test and evaluation of the integrated sonobuoy and aircraft software.

Recommendation

We recommend that you do not authorize production of the tactical surveillance sonobuoy until operational test and evaluation demonstrates that it will function effectively when integrated with the new aircraft software.

Agency Comments and Our Evaluation

In commenting on a draft of our report, the Department of Defense agreed with most of the facts as presented (see app. I) but stated that even though the sonobuoy and aircraft software will not be tested as an integrated system before the low-rate initial production decision, the risk is low that the sonobuoy will need modification later. The Department stated that the sonobuoy will be tested with part of the aircraft software and these results will indicate whether the sonobuoy and aircraft will work as a system. The Department explained that two software packages have to be added to the aircraft. One package is expected to be available before testing begins, and the one that will not be available provides functions that can be performed manually for the test. As a result, the area to be covered by sonobuoys in the test will have to be limited to less than one-sixth of its expected operational size. We believe that this limitation could lead to premature conclusions about the operational effectiveness and suitability of the sonobuoy design.

Scope and Methodology

We analyzed information on the Tactical Surveillance Sonobuoy Program, including test plans, applicable regulations, and other Department of Defense and Navy documents issued during the planning and development of the system. We also discussed the acquisition strategy alternatives and other aspects of the program with Navy officials and contractor personnel.

We performed our work at the Naval Air Development Center, Warminster, Pennsylvania; the Office of the Secretary of Defense, Naval Air Systems Command, and Naval Technical Intelligence Center, Washington, D.C.; the Naval Air Test Center, Patuxent River, Maryland; the Operational Test and Evaluation Force, Norfolk, Virginia; Hazeltine/Sipican Joint Venture, Braintree, Massachusetts; and Magnavox Electronic Systems Company, Fort Wayne, Indiana. We conducted our review from July 1989 to November 1990 in accordance with generally accepted government auditing standards.

We are sending copies of this report to the Chairmen, House and Senate Committees on Armed Services and on Appropriations, and the Director, Office of Management and Budget. We will also make copies available to others on request.

Please contact me at (202) 275-6504 if you or your staff have any questions concerning this report. Major contributors to this report are listed in appendix II.

Sincerely yours,

A handwritten signature in black ink, appearing to read "Martin M. Ferber", with a long horizontal stroke extending to the right.

Martin M Ferber
Director, Navy Issues

Comments From the Department of Defense



DIRECTOR OF DEFENSE RESEARCH AND ENGINEERING

WASHINGTON, DC 20301-3010

27 NOV 1990

Mr. Frank C. Conahan
Assistant Comptroller General
National Security and
International Affairs Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Conahan:

This is the Department of Defense (DoD) response to the General Accounting Office (GAO) draft report entitled "ANTISUBMARINE WARFARE: Tactical Surveillance Sonobuoy Needs System-Level Testing," (GAO Code 394316), OSD Case 8498. The DoD partially agrees with the draft report's findings and its single recommendation.

The DoD does not agree that the planned acquisition of the sonobuoy features risk, in that low-rate production quantities would be procured without complete system-level testing of the sonobuoy in conjunction with the associated software in the aircraft avionics. The risk is minimal due to the fact that all functions of the sonobuoy will be tested with the aircraft software before a decision for low-rate production of the buoy. Later tests will include higher-level aircraft software, which will interface the previously tested sonobuoy specific software into a data/display management system. There is little likelihood that the later tests will show the need for any changes to the sonobuoy design.

The detailed DoD comments on each finding and the recommendation are provided in the enclosure. The DoD appreciates the opportunity to comment on the draft report.

Sincerely,

A handwritten signature in dark ink, appearing to read "Charles M. Herzfeld".

Charles M. Herzfeld

Enclosure

GAO DRAFT REPORT - DATED OCTOBER 10, 1990
(GAO CODE 394316) OSD CASE 8498

"ANTISUBMARINE WARFARE: TACTICAL SURVEILLANCE
SONOBUOY NEEDS SYSTEM-LEVEL TESTING"

DEPARTMENT OF DEFENSE COMMENTS
* * * * *

FINDING A: The Initial Acquisition Strategy. The GAO reported that, in response to the recognition that Soviet submarines were becoming quieter, in 1986, the Navy devised and presented to the Congress a two-stage approach to developing a Tactical Surveillance Sonobuoy (TSS) program. The GAO observed that the first stage was to develop a Sonobuoy, as soon as possible, which would require only minor modification to operate with existing aircraft software. The GAO further observed that the second stage involved the development of enhanced sonobuoy and aircraft software capabilities. The GAO reported that the development and operational testing of the sonobuoy was scheduled for 1990, with a full-rate production decision in late 1990. The GAO found that the original acquisition strategy was to complete integrated operational test and evaluation before a full-rate production decision. The GAO noted that no timetable was set for the second stage of the program. (pp. 2-5/GAO Draft Report)

DOD RESPONSE: Concur.

FINDING B: Production Decision Planned Before Integrated Test. The GAO reported that, in 1988, the acquisition strategy was changed to incorporate a low rate initial production decision in 1991, and a subsequent full-rate production decision in 1993. The GAO found that the change was made because the aircraft software development necessary to utilize the sonobuoy had been delayed and was not scheduled for completion until a year after the sonobuoy would be ready for testing. The GAO found that, under the revised acquisition strategy, only the sonobuoy performance without the software will be tested before the low rate production decision scheduled for September 1991. The GAO noted that, if the low-rate production decision is approved, the Navy plans to spend nearly \$37 million in FY 1992 procurement funds to buy as many sonobuoys as possible -- up to 11,000 of them, depending on the negotiated unit price. The GAO further found, however, that there is no documented assessment of the risk of producing the sonobuoys before they are tested with the software. The GAO reported that during Fiscal Years 1992 through 1997, the Navy currently plans to procure almost 61,000 sonobuoys at a total cost of \$288.6 million. The GAO explained that the necessary aircraft software is being designed as part of a separate Navy program

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developing several software enhancements for the antisubmarine aircraft. The GAO reported that integrated operational test and evaluation of both the sonobuoy and aircraft software is now scheduled for FY 1993 to support a full-rate production decision.

The GAO concluded that the revised acquisition strategy for the Tactical Surveillance Sonobuoy program introduces added risk into the program compared to the original strategy because the sonobuoys may need to be modified as a result of system deficiencies that may not come to light until the 1993 integrated operational test and evaluation. The GAO further concluded that further delay in the software development or its failure to pass operational test and evaluation would result in the purchase of sonobuoys before they could be used.

The GAO reported that the Navy indicated that the two-phase test approach reduces program risk by isolating problems to either the sonobuoy or the software. While acknowledging that separate testing will help isolate problems, the GAO nonetheless asserted that successful testing of just the sonobuoy will not provide sufficient assurance that the sonobuoy and the aircraft will work as a system. The GAO also acknowledged that the current acquisition strategy will enable the initial operational capability date to be met. The GAO reported that, according to the Navy, if production is not started until after the sonobuoys and the software are tested together in 1993, the sonobuoys will not be delivered in time to meet the initial operational capability date. The GAO concluded, however, that meeting the initial operational capability date may not be as critical as it once was--and that, due to the lessening of tensions with the Soviets, more deliberate development and acquisition decisions can be made. (pp. 1-8/GAO Draft Report)

DOD RESPONSE: Partially concur. While it is correct that not all functions will be tested operationally as a system, the testing approach will offer ample confidence that the sonobuoy and aircraft will work as a system, prior to the low rate initial production decision. . Therefore the risk of having to modify sonobuoys is very low. There are two software packages that will be added to the P-3 Update III avionics for the Tactical Surveillance Sonobuoy System: 1) signal processing, analysis and display of the data, and 2) automated field management. The complete signal processing, analysis and display package will be integrated and operationally tested in the aircraft with the sonobuoy prior to the low rate initial production decision. That testing is planned to be accomplished by the end of the third quarter of FY 1991. The automated field management package will not be available, but those functions can be performed manually by the sensor operator. The lack of the automated field management package will limit the field size somewhat and require operator interaction for some functions, such as fly-to points and "next

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buoy" cuing.

The signal processing, analysis and display software available in the aircraft during the first of the two phases of the operational test and evaluation will allow an integrated test of the aircraft system and all performance features of the buoy. Only the automation of the field management functions will not be completed during the first phase of the operational testing to support the low rate initial production decision. The final interfacing of the two software packages is considered very low risk since similar software interfaces and interactions have been designed before. Likewise, the interface design requirements between the Tactical Surveillance Sonobuoy software in the AN/UYS-1 and USQ-78 signal processors and the automated field management software in the CP-901 tactical computer are well defined and are not expected to require any changes to the sonobuoy design, even if a second phase of the operational test and evaluation should indicate a software modification is needed.

As cited above, the approach being taken should not increase the overall risk to the program since all major technical issues dealing with detection performance, signal processing, display, and sensor operator interface will be addressed during the first phase of operational testing. In fact, the planned approach mitigates the risk of encoding a fully automated field management software package. It presents an opportunity to incorporate the test results of the first phase of the operational testing into the field management software strategy, before the second phase of operational evaluation.

FINDING C: Strategy Contradicts Policy. The GAO reported that the revised acquisition strategy is at variance with Navy guidance which sets an objective of completion of operational test and evaluation of an entire system before it can be committed to full-rate production. The GAO noted that the Navy instruction (1) indicates that this objective can be met in most smaller programs, and (2) also states that low-rate production approval is usually reserved for large programs that require extensive production line effort. The GAO concluded that the Tactical Surveillance Sonobuoy system does not meet either of these criteria, because it is not large and it does not require an extensive production line effort. The GAO found that both contractors believe there is little reason to anticipate problems in producing the sonobuoy and are confident that deliveries could begin one year after the production contract is awarded. The GAO noted that this minimizes the need to begin production before the integrated sonobuoy and aircraft software are tested. (pp. 8-9/GAO Draft Report)

DOD RESPONSE: Partially concur. While it is correct that Navy instructions state that low rate initial production approval is "usually reserved for large programs", there is no restriction

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Appendix I
Comments From the Department of Defense

to applying the risk reduction benefits to smaller programs. In the case of Tactical Surveillance Sonobuoy, the low rate initial production approval will be based upon a thorough operational testing of its major system component: the sonobuoy, signal processing and displays. This testing is believed to be adequate to identify any problems which would impact the design of the sonobuoy before production start-up. The risk of needing to redesign the sonobuoy hardware as a result of the operational evaluation of the automated field management software is negligible.

Additionally, any results of the first phase of operational testing can be folded into the field management software prior to the second phase of testing, thereby further reducing the overall program risk.

* * * * *

RECOMMENDATION

RECOMMENDATION. The GAO recommended that the Secretary of the Navy not authorize production of the Tactical Surveillance Sonobuoy to commence until there is adequate assurance that it will function effectively when integrated with the new aircraft software. (p. 9/GAO Draft Report)

DOD RESPONSE: Partially concur. The DoD agrees that adequate performance must be demonstrated, through operational testing, before production begins. However the DoD does not believe that additional direction by the Secretary of the Navy is necessary, because adequate testing will be performed with both the sonobuoy and the aircraft software to demonstrate their functionality prior to the low rate initial production decision. The DoD is confident that the existing acquisition strategy will provide the necessary assurance, because the portions of the related software that could affect the sonobuoy design will undergo full operational testing before the low-rate production decision.

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Major Contributors to This Report

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